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(54) Athletic shoe.

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US-A- 1 471 966
US-A- 4 843 737

(73) Proprietor: **Wilson Sporting Goods Company**
2233 West Street
River Grove Illinois 60171(US)

(72) Inventor: **Crowley, Kevin J.**
Pickpocket Box 30
Brentwood New Hampshire 03833(US)

(74) Representative: **McCall, John Douglas et al**
W.P. THOMPSON & CO.
Coopers Building
Church Street
Liverpool L1 3AB (GB)

EP 0 359 421 B1

Description

This invention relates to athletic shoes, and, more particularly, to an athletic shoe which includes a spring in the heel portion of the sole.

Various attempts have been made to provide athletic shoes with shock absorbing or energy storing devices such as resilient materials and springs. For example, WO-A-8103602 describes a shoe comprising a sole, an upper attached to the sole, and a spring positioned in a chamber of this sole, the spring having top and bottom walls which are joined and which are convex. A shock absorbing material cushions the shock of the foot striking the ground. Some shock absorbing materials absorb energy and dissipate it as heat. The athlete therefore loses a portion of his kinetic energy every time his foot strikes the ground. An energy storing device stores energy as the foot strikes the ground and returns energy to the athlete as the foot leaves the ground.

The cushioning or energy storing device should be confined within the sole, but the height of the sole should be maintained within certain desired limits. In other words, the sole should not be excessively thick. The height or thickness constraint has limited the effectiveness of previous cushioning and energy striking materials.

The energy storing device should also be lightweight. Some prior attempts to provide energy storing devices in shoes have resulted in shoes which were too heavy. For example, dress shoes and work shoes have been provided with steel springs, but steel springs are too heavy for athletic shoes such as tennis or basketball shoes.

The invention provides a lightweight yet durable spring for an athletic shoe which can deflect substantially to cushion the foot but which will store and return energy to the foot.

According to the present invention there is provided an athletic shoe comprising a sole, an upper attached to the sole, and a spring positioned in a spring chamber of the sole, the spring having top and bottom walls which are joined at the front and rear ends thereof, one of the walls being convexly curved, the spring having a centre opening which extends laterally through the spring between the top and bottom walls, and the sole is provided with openings in each side thereof which communicate the spring chamber with the exterior of the sole, the centre opening of the spring being aligned with the openings of the sole.

Preferably the spring is generally oval-shaped and includes convex top and bottom walls which are joined at the front and back ends.

The spring is preferably moulded from lightweight high tensile strength materials such as graphite fibres and resin, kevlar fibres (Kevlar is a registered Trad Mark) and resin, glass fibres and resin, and ceramic materials. Th high tensile str ngth materials provide a light w ight spring with a low profile which can be confined within the height of a normal sole while still providing advantageous deflection and energy storing.

The invention will be further described by way of example with reference to the accompanying drawings, in which:-

Fig. 1 is a perspective view of an athletic shoe equipped with an energy storing spring in accordance with the invention;

Fig. 2 is a fragmentary side elevational view of the shoe;

Fig. 3 is a fragmentary top plan view of the sole of the shoe;

Fig. 4 is a sectional view taken along the line 4-4 of Fig. 3;

Fig. 5 is a side elevational view of the energy storing spring;

Fig. 6 is a top plan view of the spring;

Fig. 7 is a perspective view of the midsole of the shoe;

Fig. 8 is a perspective view of the outsole of the shoe;

Fig. 9 is a perspective view of the assembled outsole and midsole;

Fig. 10 is a perspective view of the spring showing a downward force being applied to the spring.

Fig. 11 is a perspective view of the spring in a deformed condition; and

Fig. 12 is a perspective view of the spring rebounding from the deformed condition.

Referring first to Fig. 1, an athletic shoe 15 includes a sole 16 and an upper 17. The upper includes the usual tongue 18 and eyelets 19 for a shoelace. The upper can be conventional and can be formed from leather, canvas, and/or synthetic material. The invention can be used in various types of athletic shoes, for example, tennis shoes, basketball shoes, running shoes, etc.

The particular sole 16 illustrated includes an outsole 21 and a midsole 22 (see also Figs. 7 to 9). The outsole can be formed from conventional abrasion-resistant material such as rubber or other conventional materials. The midsole is moulded from more resilient material such as polyurethane. An insole can be provided if desired.

The outsole 21 includes a bottom layer 23 which provides the bottom surface of the sole, a toe cap portion 24 which extends upwardly from the front end of the bottom layer, and side and rear portions 25 and 26 which are spaced from the bottom layer. If desired, however, the side and rear portions can ext nd upwardly from th bottom layer.

The midsole 22 includes upper and lower halves 28 and 29 which are joined together and which provide a to portion 30, an arch or instep portion 31, and a heel portion 32. If desired, vertical bores or passages 33 (Figs. 3 and 4) can be provided in the instep portion to reduce the weight of the sole.

A generally oval-shaped spring 35 (Figs. 5 and 6) is positioned within a spring chamber 36 (Fig. 3) in the heel portion of the midsole before the upper and lower halves of the midsole are secured. The spring includes convexly curved top and bottom walls 37 and 38 which are joined along their front and rear ends 39 and 40. A central opening 41 extends laterally through the spring between the sides 42.

The height H of the spring is advantageously within the range of about 10 to 15 mm. so that it can be confined within a normal size midsole. The particular spring illustrated has a height H of 14 mm., a length L of 76 mm., and a width W of 56 mm. The thickness T of both the top and bottom walls is 1.5 mm. The maximum height h of the opening 41 is 11 mm. If desired, the bottom wall 38 can be thicker than the top wall 37 so that the top wall will deform more easily and the outsole will not be distorted.

Even though the spring has a low profile or height, the spring is provided with good hardness and energy-storing capability by molding the spring from high tensile strength composite material. The spring can be moulded from graphite fibres and resin, kevlar fibres and resin, glass fibres and resin, or ceramic materials. The oval shape of the spring provides good deflection and resilience and minimizes the height.

Referring to Fig. 3, the spring chamber 36 in the midsole is provided with shoulders 44 which abut the sides of the spring and maintain the spring in the proper position. Lateral openings 45 (Figs. 1, 2, and 7) extend from the spring chamber to the outside of the midsole. The surfaces of the midsole which contact the convex top and bottom walls of the spring can be shaped to mate with the curvature of the spring.

When a downward force F is applied by the foot to the heel portion of the midsole, the spring 35 is deformed as illustrated in Figs. 10 and 11. The spring illustrated in Figs. 10 to 12 has a top wall 37 which is thinner than the bottom wall 38, and the top wall therefore deforms more readily than the bottom wall. The deformed spring stores energy, and when the downward force is released, the spring rebounds to its original shape and returns th stored energy to th foot as indicated by the arrow F'.

The thickness of the top and bottom walls of the spring can be varied as desired to provide an optimum blend of cushioning and nergy storing charact ristics. A softer, more deformable spring will provide gr at r cushioning, and harder, more rigid spring will store and return more energy.

In the preferred embodiment of the spring both the top and bottom walls are convexly curved. However, if desired, one of the walls can be relatively flat.

In the particular embodiment illustrated, the sole is comprised of a separate outsole and a separate midsole, and the spring is positioned in the midsole. It will be understood, however, that the insole and outsole can form an integral sole.

Claims

1. An athletic shoe comprising a sole (16), an upper (17) attached to the sole, and a spring (35) positioned in a spring chamber (36) of the sole, the spring having top and bottom walls (37 and 38) which are joined at the front and rear ends thereof, one of the walls being convexly curved, characterised in that the spring has a centre opening (41) which extends laterally through the spring between the top and bottom walls, and the sole is provided with openings (45) in each side thereof which communicate the spring chamber (36) with the exterior of the sole, the centre opening (41) of the spring being aligned with the openings of the sole.

2. A shoe as claimed in claim 1 in which both of the top and bottom walls (37 and 38) of the spring are convexly curved.

3. A shoe as claimed in claim 1 or 2, in which the spring (35) is made from moulded graphite fibres and resin, or moulded glass fibres and resin, or moulded ceramic material.

4. A shoe as claimed in any one of the preceding claims, in which the sole (16) includes an outsole (21) and a midsole (22) above the outsole, the midsole (22) having top and bottom surfaces (28, 29) and in which said spring chamber (36) is positioned between the top and bottom surfaces (28, 29).

5. A shoe as claimed in claim 4, in which the midsole (22) is moulded from polyurethane.

6. A shoe as claimed in claim 4, or 5, in which the midsole (22) has a heel portion (32), an instep portion (31), and a toe portion (30), the spring (35) being positioned in the heel portion (32) of th sol (22).

7. A sho as claimed in any one of the preceding claims, in which the misdole (22) includes a pair of shoulders (44) on each side of the spring chamber (36) for retaining the spring (35) in the spring chamber (36).

8. A shoe as claimed in any one of the preceding claims, in which both walls of the spring (35) are convexly curved and the bottom wall is thicker than the top wall.

9. A shoe as claimed in any one of the preceding claims, in which the height of the spring (35) is within the range of about 10 to 15 mm.

Patentansprüche

1. Sportschuh bestehend aus einer Sohle (16), einem an der Sohle befestigten Schaftteil (17), einer in einer Federkammer (36) der Sohle angeordneten Feder (35), welche ein oberes und ein unteres Blatt (37 und 38) besitzt, die an dem vorderen und hinteren Ende derselben miteinander verbunden sind, wobei eines der Blätter konvex gewölbt ist, dadurch gekennzeichnet, daß die Feder ein mittleres, sich seitlich durch die Feder zwischen dem oberen und unteren Blatt erstreckende Öffnung (41) besitzt, und die Sohle an jeder ihrer Seiten mit Öffnungen (45) versehen ist, die die Federkammer (36) mit der Außensohle verbinden, wobei die mittlere Federöffnung (41) auf die Sohlenöffnungen ausgerichtet ist.

2. Schuh nach Anspruch 1, bei dem das obere und das untere Federblatt (37 und 38) beide konvex gewölbt sind.

3. Schuh nach Anspruch 1 oder 2, bei dem die Feder (35) aus vorgeformten Graphitfasern und Harz oder vorgeformten Glasfasern und Harz oder vorgeformtem Keramikmaterial besteht.

4. Schuh nach einem der vorhergehenden Ansprüche, bei dem die Sohle (16) eine Außensohle (21) und eine Halbsohle (22) oberhalb der Außensohle enthält, wobei die Halbsohle (22) eine obere und untere Fläche (28, 29) besitzt, und bei dem die genannte Federkammer (36) zwischen der oberen und unteren Fläche (28, 29) angeordnet ist.

5. Schuh nach Anspruch 4, bei dem die Halbsohle (22) aus Polyurethan vorgeformt ist.

6. Schuh nach Anspruch 4 oder 5, bei dem die Halbsohle (22) einen Fersenteil (32), einen Ristteil (31) und einen Zehenteil (oder Vorderteil) (30) besitzt, wobei die Feder (35) im Fersenteil (32) der Sohle (22) angeordnet ist.

7. Schuh nach einem der vorhergehenden Ansprüche, bei dem die Halbsohle (22) an jeder Seite der Federkammer (36) ein Schulterpaar (44) enthält, um die Feder (35) in der Federkammer (36) zu halten.

8. Schuh nach einem der vorhergehenden Ansprüche, bei dem beide Blätter der Feder (35) konvex gewölbt sind und das untere Blatt dikker als das obere Blatt ist.

9. Schuh nach einem der vorhergehenden Ansprüche, bei dem die Höhe der Feder (35) im Bereich von circa 10 bis 15 mm liegt.

Revendications

1. Une chaussure de sport comprenant une semelle (16), une empeigne (17) attachée à la semelle, et un ressort (35) logé dans une chambre ressort (36) de la semelle, le ressort ayant des parois supérieure et inférieure (37 et 38) qui sont jointes à leurs extrémités antérieure et postérieure, une de ces parois étant courbée de manière convexe, caractérisée en ce que le ressort a une ouverture centrale (41) qui s'étend latéralement à travers le ressort entre les parois supérieure et inférieure, et la semelle est pourvue d'ouvertures (45) dans chacun de ses côtés qui fait communiquer la chambre ressort (36) avec l'extérieur de la semelle, l'ouverture centrale (41) du ressort étant alignée avec les ouvertures de la semelle.

2. Une chaussure selon la revendication 1 dans laquelle las parois supérieure et inférieure (37 et 38) du ressort sont toutes deux courbées de manière convexe.

3. Une chaussure selon la revendication 1 ou 2, dans laquelle le ressort (35) est réalisé en fibres de graphite et résine moulées, ou fibres de verre et résine moulées, ou en materiel céramique moulé.

4. Une chaussure selon une quelconque des revendications précédentes dans laquelle la semelle (16) comprend une semelle extérieure (21) et un patin (22) au dessus de la semelle extérieure, le patin (22) ayant des surfaces supérieur et inférieur (28, 29) et dans laquel l ladite chambre ressort (36) est logée entre les surfaces supéri ur et inférieur (28, 29).

5. Un chaussure selon la revendication 4 dans laquelle le patin (22) est en polyurethane moulé.

6. Une chaussure selon la revendication 4, ou 5, dans laquelle le patin (22) comprend des parties correspondant au talon (32), au cou-de-pied (31), et à la pointe (30), le ressort (35) étant logé dans le talon (32) de la semelle (22).

7. Une chaussure selon une quelconque des revendications précédentes dans laquelle le patin (22) comprend une paire d'épaulements (44) sur chaque côté de la chambre ressort (36) pour retenir le ressort (35) dans la chambre ressort (36).

8. Une chaussure selon une quelconque des revendications précédentes dans laquelle les deux parois du ressort (35) sont courbées de manière convexe et la paroi inférieure est plus épaisse que la paroi supérieure.

9. Une chaussure selon une quelconque des revendications précédentes dans laquelle la hauteur du ressort (35) est compris dans l'intervalle d'environ 10 à 15 mm.

FIG. 1

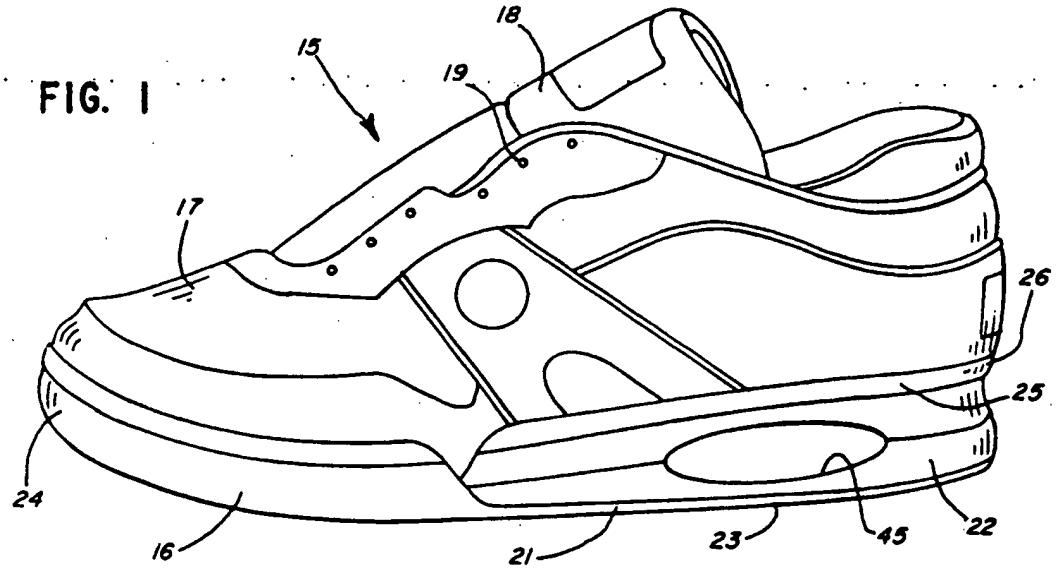


FIG. 2

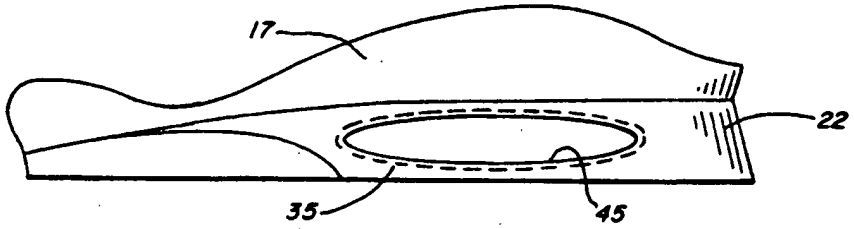
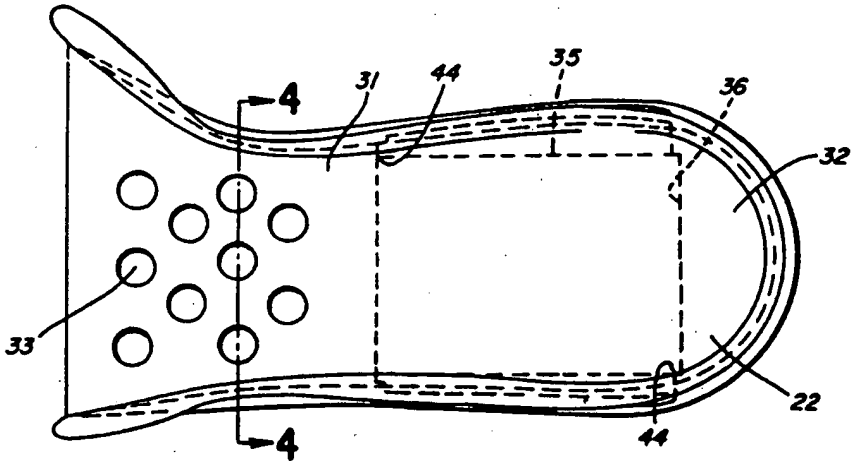


FIG. 3



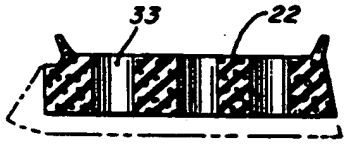
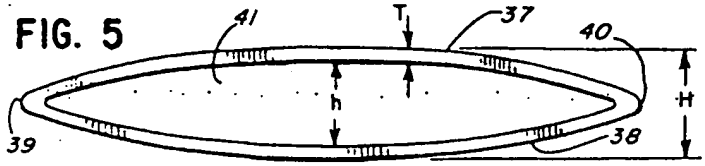


FIG. 4

FIG. 5



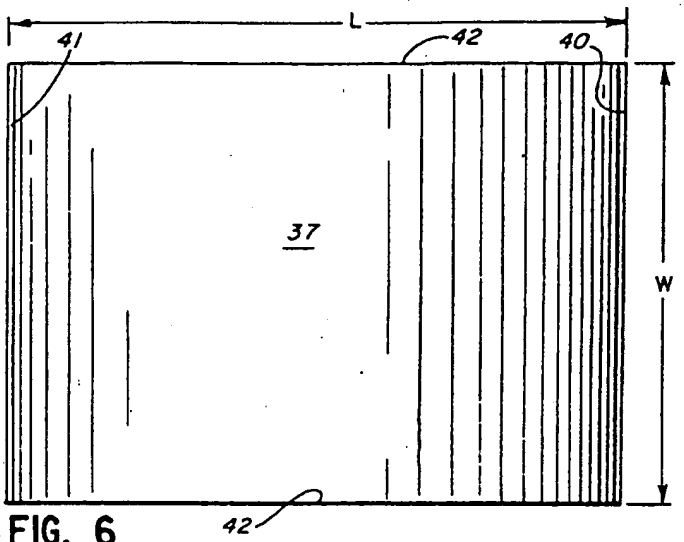


FIG. 6

FIG. 10

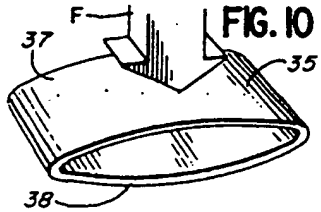
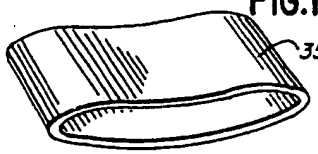


FIG. 11



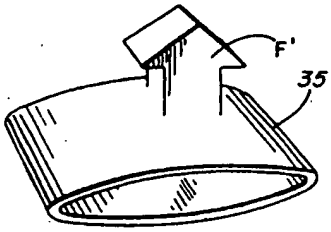


FIG. 12

FIG. 7

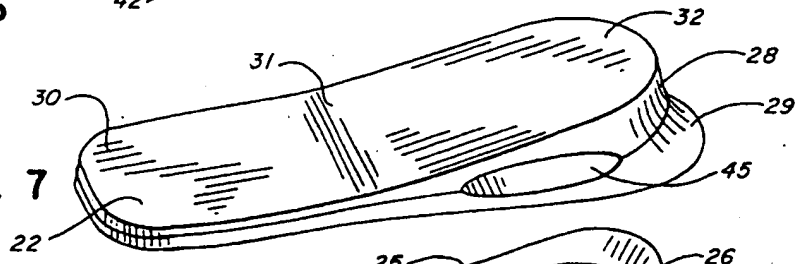


FIG. 8

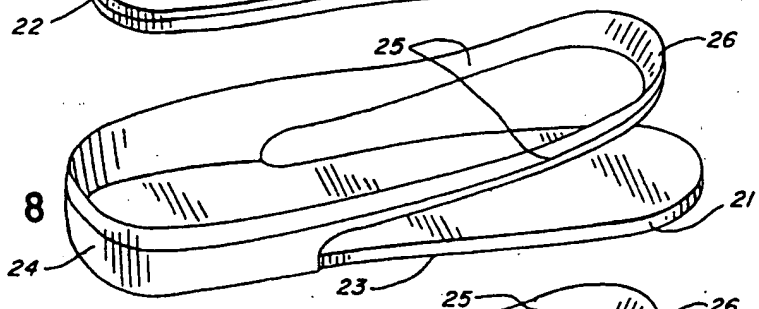
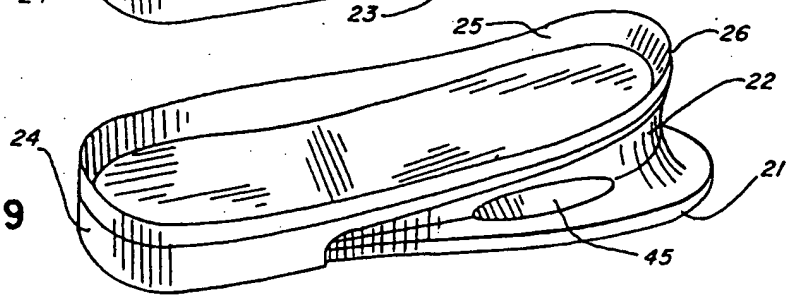


FIG. 9



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(54) Athletic shoe.

(57) An athletic shoe includes a spring (35) preferably in the midsole (22) of the shoe. The spring (35) is preferably generally oval-shaped and includes convex top and bottom walls (37, 38) and a laterally extending opening (41). The spring preferably is moulded from high tensile material such as graphite fibres and resin, kevlar fibres and resin, glass fibres and resin, or ceramic materials.

FIG. 2

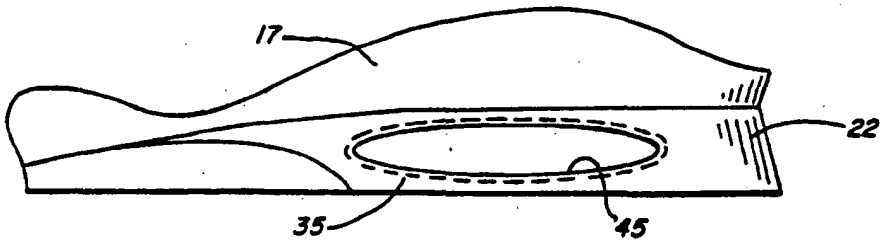
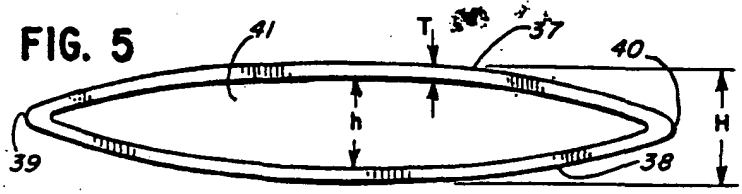


FIG. 5



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ATHLETIC SHOE

This invention relates to athletic shoes, and, more particularly, to an athletic shoe which includes a spring in the heel portion of the sole.

Various attempts have been made to provide athletic shoes with shock absorbing or energy storing devices such as resilient materials and springs. A shock absorbing material cushions the shock of the foot striking the ground. Some shock absorbing materials absorb energy and dissipate it as heat. The athlete therefore loses a portion of his kinetic energy every time his foot strikes the ground. An energy storing device stores energy as the foot strikes the ground and returns energy to the athlete as the foot leaves the ground.

The cushioning or energy storing device should be confined within the sole, but the height of the sole should be maintained within certain desired limits. In other words, the sole should not be excessively thick. The height or thickness constraint has limited the effectiveness of previous cushioning and energy striking materials.

The energy storing device should also be lightweight. Some prior attempts to provide energy storing devices in shoes have resulted in shoes which were too heavy. For example, dress shoes and work shoes have been provided with steel springs, but steel springs are too heavy for athletic shoes such as tennis or basketball shoes.

The invention provides a lightweight yet durable spring for an athletic shoe which can deflect substantially to cushion the foot but which will store and return energy to the foot. Preferably the spring is generally oval-shaped and includes convex top and bottom walls which are joined at the front and back ends. A central opening extends laterally through the spring. The spring is preferably moulded from lightweight high tensile strength materials such as graphite fibres and resin, kevlar fibres and resin, glass fibres and resin, and ceramic materials. The high tensile strength materials provide a light weight spring with a low profile which can be confined within the height of a normal sole while still providing advantageous deflection and energy storing.

The invention will be further described by way of example with reference to the accompanying drawings, in which:-

Fig. 1 is a perspective view of an athletic shoe equipped with an energy storing spring in accordance with the invention;

Fig. 2 is a fragmentary side elevational view of th shoe;

Fig. 3 is a fragmentary top plan view of the sole of the shoe;

Fig. 4 is a sectional view taken along the line 4-4 of Fig. 3;

Fig. 5 is a side elevational view of the energy storing spring;

Fig. 6 is a top plan view of the spring;

Fig. 7 is a perspective view of the midsole of the shoe;

Fig. 8 is a perspective view of the outsole of the shoe;

Fig. 9 is a perspective view of the assembled outsole and midsole;

Fig. 10 is a perspective view of the spring showing a downward force being applied to the spring.

Fig. 11 is a perspective view of the spring in a deformed condition; and

Fig. 12 is a perspective view of the spring rebounding from the deformed condition.

Referring first to Fig. 1 an athletic shoe 15 includes a sole 16 and an upper 17. The upper includes the usual tongue 18 and eyelets 19 for a shoelace. The upper can be conventional and can be formed from leather, canvas, and/or synthetic material. The invention can be used in various types of athletic shoes, for example, tennis shoes, basketball shoes, running shoes, etc.

The particular sole 16 illustrated includes an outsole 21 and a midsole 22 (see also Figs. 7 to 9). The outsole can be formed from conventional abrasion-resistant material such as rubber or other conventional materials. The midsole is moulded from more resilient material such as polyurethane. An insole can be provided if desired.

The outsole 21 includes a bottom layer 23 which provides the bottom surface of the sole, a toe cap portion 24 which extends upwardly from the front end of the bottom layer, and side and rear portions 25 and 26 which are spaced from the bottom layer. If desired, however, the side and rear portions can extend upwardly from the bottom layer.

The midsole 22 includes upper and lower halves 28 and 29 which are joined together and which provide a toe portion 30, an arch or instep portion 31, and a heel portion 32. If desired, vertical bores or passages 33 (Figs. 3 and 4) can be provided in the instep portion to reduce the weight of the sole.

A generally oval-shaped spring 35 (Figs. 5 and 6) is positioned within a spring chamber 36 (Fig. 3) in the heel portion of the midsole before the upper and lower halves of the midsole are secured. The spring includes convexly curved top and bottom walls 37 and 38 which are joined along their front and rear ends 39 and 40. A central opening 41 extends laterally through the spring between the

sides 42.

The height H of the spring is advantag ously within the range of about 10 to 15 mm. so that it can be confined within a normal size midsole. The particular spring illustrated has a height H of 14 mm., a length L of 76 mm., and a width W of 56 mm. The thickness T. of both the top and bottom walls is 1.5 mm. The maximum height h of the opening 41 is 11 mm. If desired, the bottom wall 38 can be thicker than the top wall 37 so that the top wall will deform more easily and the outsole will not be distorted.

Even though the spring has a low profile or height, the spring is provided with good hardness and energy-storing capability by molding the spring from high tensile strength composite material. The spring can be moulded from graphite fibres and resin, kevlar fibres and resin, glass fibres and resin, or ceramic materials. The oval shape of the spring provides good deflection and resilience and minimizes the height.

Referring to Fig. 3, the spring chamber 36 in the midsole is provided with shoulders 44 which abut the sides of the spring and maintain the spring in the proper position. Lateral openings 45 (Figs. 1, 2, and 7) extend from the spring chamber to the outside of the midsole. The surfaces of the midsole which contact the convex top and bottom walls of the spring can be shaped to mate with the curvature of the spring.

When a downward force F is applied by the foot to the heel portion of the midsole, the spring 35 is deformed as illustrated in Figs. 10 and 11. The spring illustrated in Figs. 10 to 12 has a top wall 37 which is thinner than the bottom wall 38, and the top wall therefore deforms more readily than the bottom wall. The deformed spring stores energy, and when the downward force is released, the spring rebounds to its original shape and returns the stored energy to the foot as indicated by the arrow F'.

The thickness of the top and bottom walls of the spring can be varied as desired to provide an optimum blend of cushioning and energy storing characteristics. A softer, more deformable spring will provide greater cushioning, and harder, more rigid spring will store and return more energy.

In the preferred embodiment of the spring both the top and bottom walls are convexly curved. However, if desired, one of the walls can be relatively flat.

In the particular embodiment illustrated, the sole is comprised of a separate outsole and a separate midsole, and the spring is positioned in the midsole. It will be understood, however, that the insole and outsole can form an integral sole.

While in th foregoing specification a detailed description of a specific embodiment of the invention was set forth for th purpose of illustration, it will b understodd that many of the details herein given may be varied considerably by those skill d in the art without departing from the spirit and scope of the invention.

Claims

1. An athletic shoe comprising a sole (16), an upper (17) attached to the sole, and characterised by a spring (35) positioned in the sole (16), the spring having top and bottom walls (37 and 38) which are joined at the front and rear ends thereof and a centre opening (41) which extends laterally through the spring (35) between the top and bottom walls (37 and 38), one of the walls being convexly curved.

2. A shoe as claimed in claim 1 characterised in that both of the top and bottom walls (37 and 38) of the spring are convexly curved.

3. A shoe as claimed in claim 1 or 2, characterised in that the spring (35) is made from moulded graphite fibres and resin, or moulded kevlar fibres and resin, or moulded glass fibres and resin, or moulded ceramic material.

4. A shoe as claimed in any one of the preceding claims, characterised in that the sole (16) includes an outsole (21) and a midsole (22) above the outsole, the midsole (22) having top and bottom surfaces (28, 29) and a spring chamber (36) between the top and bottom surfaces (28, 29), the spring (35) being positioned within the spring chamber (36).

5. A shoe as claimed in claim 4 characterised in that the midsole (22) is moulded from polyurethane.

6. A shoe as claimed in claim 4, or 5, characterised in that the midsole (22) has a heel portioin (32), an instep portion (31), and a toe portion (30), the spring (35) being positioned in the heel portion (32) of the sole (22).

7. A shoe as claimed in any one of claims 4 to 6 characterised in that the midsole (22) is provided with the openings (45) in each side thereof which communicate the spring chamber (36) with the exterior of the midsole (22).

8. A shoe as claimed in claim 7 characterised in that the misdole (22) includes a pair of shoulders (44) on each side of the spring chamber (36) for retaining the spring (35) in the spring chamber (36).

9. A shoe as claimed in any one of the preceding claims, characterised in that both walls of the spring (35) are convexly curved and th bottom wall is thicker than the top wall.

10. A shoe as claimed in any one of the preceding claims, characterised in that the height

of the spring (35) is within th range of about 10 to 15 mm.

FIG. 1

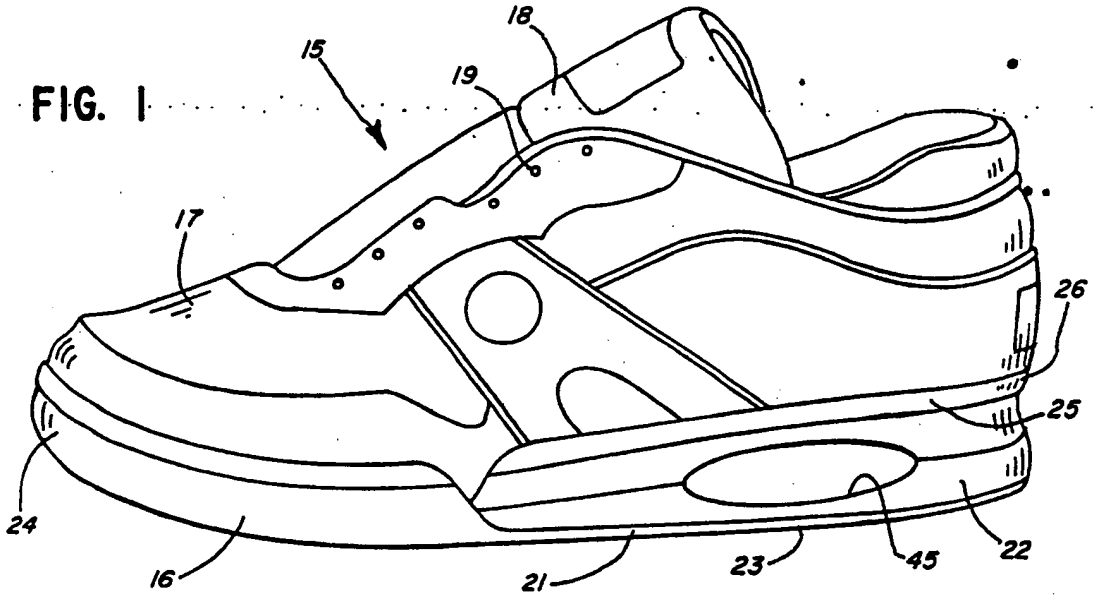
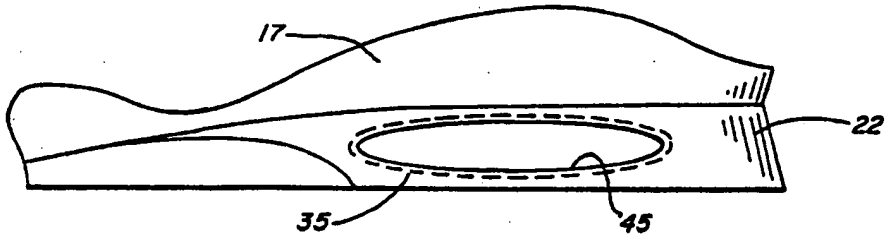


FIG. 2



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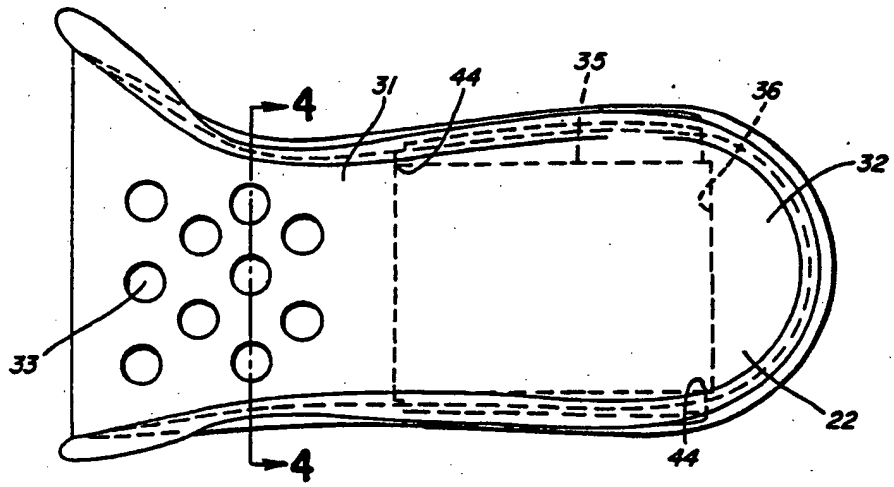


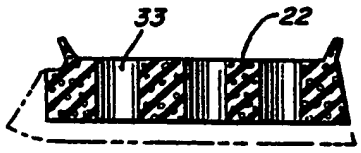
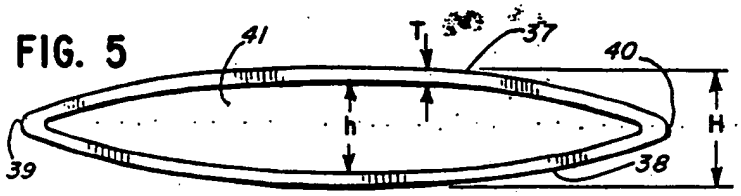


FIG. 4

FIG. 5



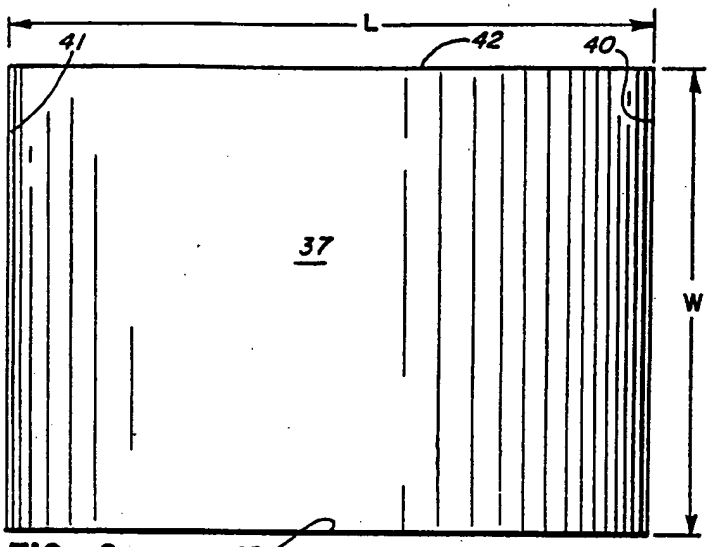


FIG. 6

FIG. 10

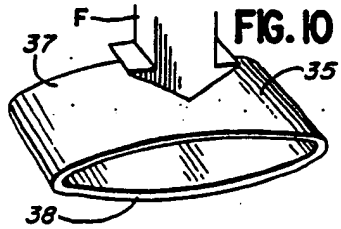
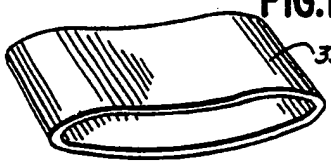


FIG. 11



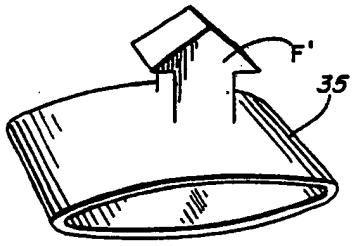


FIG. 12

FIG. 7

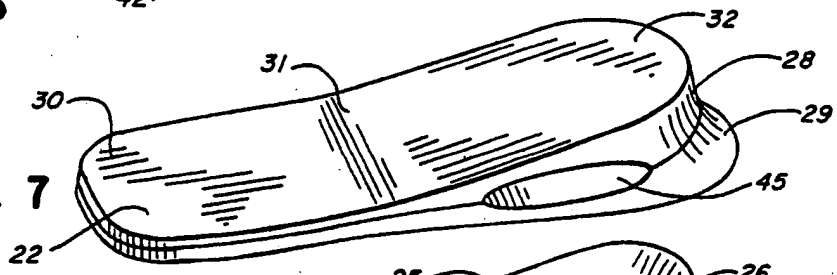


FIG. 8

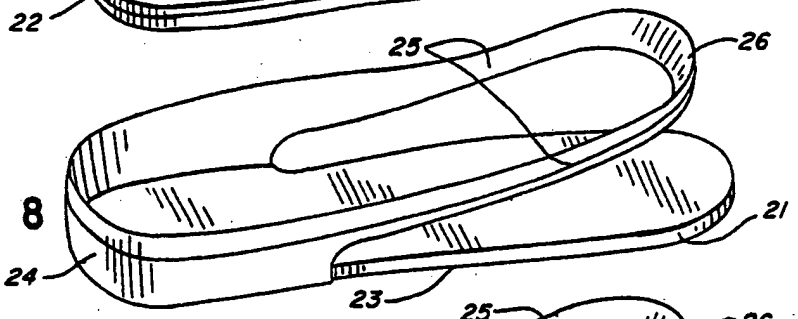
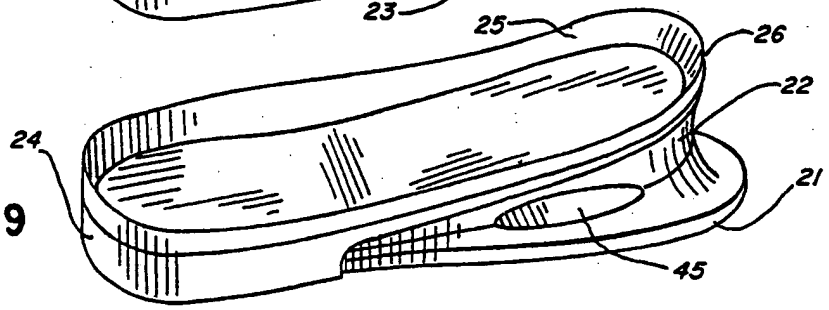


FIG. 9



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(71) Applicant: Wilson Sporting Goods Company
2233 West Street
River Grove Illinois 60171(US)

(72) Inventor: Crowley, Kevin J.
Pickpocket Box 30
Brentwood New Hampshire 03833(US)

(74) Representative: McCall, John Douglas et al
W.P. THOMPSON & CO. Coopers Building
Church Street
Liverpool L1 3AB(GB)

(54) Athletic shoe.

(57) An athletic shoe includes a spring (35) preferably in the midsole (22) of the shoe. The spring (35) is preferably generally oval-shaped and includes convex top and bottom walls (37, 38) and a laterally extending opening (41). The spring preferably is moulded from high tensile material such as graphite fibres and resin, kevlar fibres and resin, glass fibres and resin, or ceramic materials.

FIG. 2

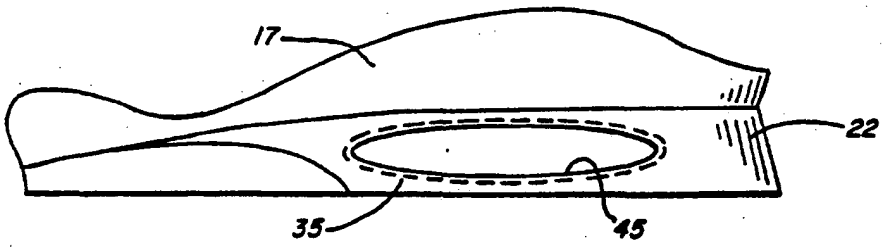
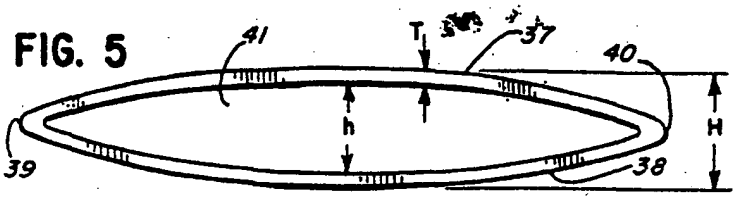


FIG. 5



EP 0 359 421 A2

ATHLETIC SHOE

This invention relates to athletic shoes, and, more particularly, to an athletic shoe which includes a spring in the heel portion of the sole.

Various attempts have been made to provide athletic shoes with shock absorbing or energy storing devices such as resilient materials and springs. A shock absorbing material cushions the shock of the foot striking the ground. Some shock absorbing materials absorb energy and dissipate it as heat. The athlete therefore loses a portion of his kinetic energy every time his foot strikes the ground. An energy storing device stores energy as the foot strikes the ground and returns energy to the athlete as the foot leaves the ground.

The cushioning or energy storing device should be confined within the sole, but the height of the sole should be maintained within certain desired limits. In other words, the sole should not be excessively thick. The height or thickness constraint has limited the effectiveness of previous cushioning and energy striking materials.

The energy storing device should also be lightweight. Some prior attempts to provide energy storing devices in shoes have resulted in shoes which were too heavy. For example, dress shoes and work shoes have been provided with steel springs, but steel springs are too heavy for athletic shoes such as tennis or basketball shoes.

The invention provides a lightweight yet durable spring for an athletic shoe which can deflect substantially to cushion the foot but which will store and return energy to the foot. Preferably the spring is generally oval-shaped and includes convex top and bottom walls which are joined at the front and back ends. A central opening extends laterally through the spring. The spring is preferably moulded from lightweight high tensile strength materials such as graphite fibres and resin, kevlar fibres and resin, glass fibres and resin, and ceramic materials. The high tensile strength materials provide a light weight spring with a low profile which can be confined within the height of a normal sole while still providing advantageous deflection and energy storing.

The invention will be further described by way of example with reference to the accompanying drawings, in which:-

Fig. 1 is a perspective view of an athletic shoe equipped with an energy storing spring in accordance with the invention;

Fig. 2 is a fragmentary side elevational view of the shoe;

Fig. 3 is a fragmentary top plan view of the sole of the shoe;

Fig. 4 is a sectional view tak n along the line 4-4 of Fig. 3;

Fig. 5 is a side elevational view of the energy storing spring;

Fig. 6 is a top plan view of the spring;

Fig. 7 is a perspective view of the midsole of the shoe;

Fig. 8 is a perspective view of the outsole of the shoe;

Fig. 9 is a perspective view of the assembled outsole and midsole;

Fig. 10 is a perspective view of the spring showing a downward force being applied to the spring.

Fig. 11 is a perspective view of the spring in a deformed condition; and

Fig. 12 is a perspective view of the spring rebounding from the deformed condition.

Referring first to Fig. 1 an athletic shoe 15 includes a sole 16 and an upper 17. The upper includes the usual tongue 18 and eyelets 19 for a shoelace. The upper can be conventional and can be formed from leather, canvas, and/or synthetic material. The invention can be used in various types of athletic shoes, for example, tennis shoes, basketball shoes, running shoes, etc.

The particular sole 16 illustrated includes an outsole 21 and a midsole 22 (see also Figs. 7 to 9). The outsole can be formed from conventional abrasion-resistant material such as rubber or other conventional materials. The midsole is moulded from more resilient material such as polyurethane. An insole can be provided if desired.

The outsole 21 includes a bottom layer 23 which provides the bottom surface of the sole, a toe cap portion 24 which extends upwardly from the front end of the bottom layer, and side and rear portions 25 and 26 which are spaced from the bottom layer. If desired, however, the side and rear portions can extend upwardly from the bottom layer.

The midsole 22 includes upper and lower halves 28 and 29 which are joined together and which provide a toe portion 30, an arch or instep portion 31, and a heel portion 32. If desired, vertical bores or passages 33 (Figs. 3 and 4) can be provided in the instep portion to reduce the weight of the sole.

A generally oval-shaped spring 35 (Figs. 5 and 6) is positioned within a spring chamber 36 (Fig. 3) in the heel portion of the midsole before the upper and lower halves of the midsole are secured. The spring includes convexly curved top and bottom walls 37 and 38 which are joined along their front and rear ends 39 and 40. A central opening 41 extends laterally through the spring between the

sid s 42.

The height H of the spring is advantageously within the rang of about 10 to 15 mm. so that it can b confined within a normal size midsol . The particular spring illustrated has a height H of 14 mm., a length L of 76 mm., and a width W of 56 mm. The thickness T of both the top and bottom walls is 1.5 mm. The maximum height h of the opening 41 is 11 mm. If desired, the bottom wall 38 can be thicker than the top wall 37 so that the top wall will deform more easily and the outsole will not be distorted.

Even though the spring has a low profile or height, the spring is provided with good hardness and energy-storing capability by molding the spring from high tensile strength composite material. The spring can be moulded from graphite fibres and resin, kevlar fibres and resin, glass fibres and resin, or ceramic materials. The oval shape of the spring provides good deflection and resilience and minimizes the height.

Referring to Fig. 3, the spring chamber 36 in the midsole is provided with shoulders 44 which abut the sides of the spring and maintain the spring in the proper position. Lateral openings 45 (Figs. 1, 2, and 7) extend from the spring chamber to the outside of the midsole. The surfaces of the midsole which contact the convex top and bottom walls of the spring can be shaped to mate with the curvature of the spring.

When a downward force F is applied by the foot to the heel portion of the midsole, the spring 35 is deformed as illustrated in Figs. 10 and 11. The spring illustrated in Figs. 10 to 12 has a top wall 37 which is thinner than the bottom wall 38, and the top wall therefore deforms more readily than the bottom wall. The deformed spring stores energy, and when the downward force is released, the spring rebounds to its original shape and returns the stored energy to the foot as indicated by the arrow F'.

The thickness of the top and bottom walls of the spring can be varied as desired to provide an optimum blend of cushioning and energy storing characteristics. A softer, more deformable spring will provide greater cushioning, and harder, more rigid spring will store and return more energy.

In the preferred embodiment of the spring both the top and bottom walls are convexly curved. However, if desired, one of the walls can be relatively flat.

In the particular embodiment illustrated, the sole is comprised of a separate outsole and a separate midsole, and the spring is positioned in the midsole. It will be understood, however, that the insole and outsol can form an integral sole.

While in the foregoing specification a detailed description of a specific embodiment of the invention was set forth for the purpose of illustration, it will be understodd that many of the details herein giv n may be varied considerably by those skilled in the art without departing from th spirit and scope of the invention.

Claims

1. An athletic shoe comprising a sole (16), an upper (17) attached to the sole, and characterised by a spring (35) positioned in the sole (16), the spring having top and bottom walls (37 and 38) which are joined at the front and rear ends thereof and a centre opening (41) which extends laterally through the spring (35) between the top and bottom walls (37 and 38), one of the walls being convexly curved.

2. A shoe as claimed in claim 1 characterised in that both of the top and bottom walls (37 and 38) of the spring are convexly curved.

3. A shoe as claimed in claim 1 or 2, characterised in that the spring (35) is made from moulded graphite fibres and resin, or moulded kevlar fibres and resin, or moulded glass fibres and resin, or moulded ceramic material.

4. A shoe as claimed in any one of the preceding claims, characterised in that the sole (16) includes an outsole (21) and a midsole (22) above the outsole, the midsole (22) having top and bottom surfaces (28, 29) and a spring chamber (36) between the top and bottom surfaces (28, 29), the spring (35) being positioned within the spring chamber (36).

5. A shoe as claimed in claim 4 characterised in that the midsole (22) is moulded from polyurethane.

6. A shoe as claimed in claim 4, or 5, characterised in that the midsole (22) has a heel portioin (32), an instep portion (31), and a toe portion (30), the spring (35) being positioned in the heel portion (32) of the sole (22).

7. A shoe as claimed in any one of claims 4 to 6 characterised in that the midsole (22) is provided with the openings (45) in each side thereof which communicate the spring chamber (36) with the exterior of the midsole (22).

8. A shoe as claimed in claim 7 characterised in that the misdole (22) includes a pair of shoulders (44) on each side of the spring chamber (36) for retaining the spring (35) in the spring chamber (36).

9. A shoe as claimed in any one of the preceding claims, characterised in that both walls of the spring (35) are convexly curved and the bottom wall is thicker than th top wall.

10. A shoe as claimed in any one of the preceding claims, characteris d in that the height

of th spring (35) is within the range of about 10 to 15 mm.

FIG. 1

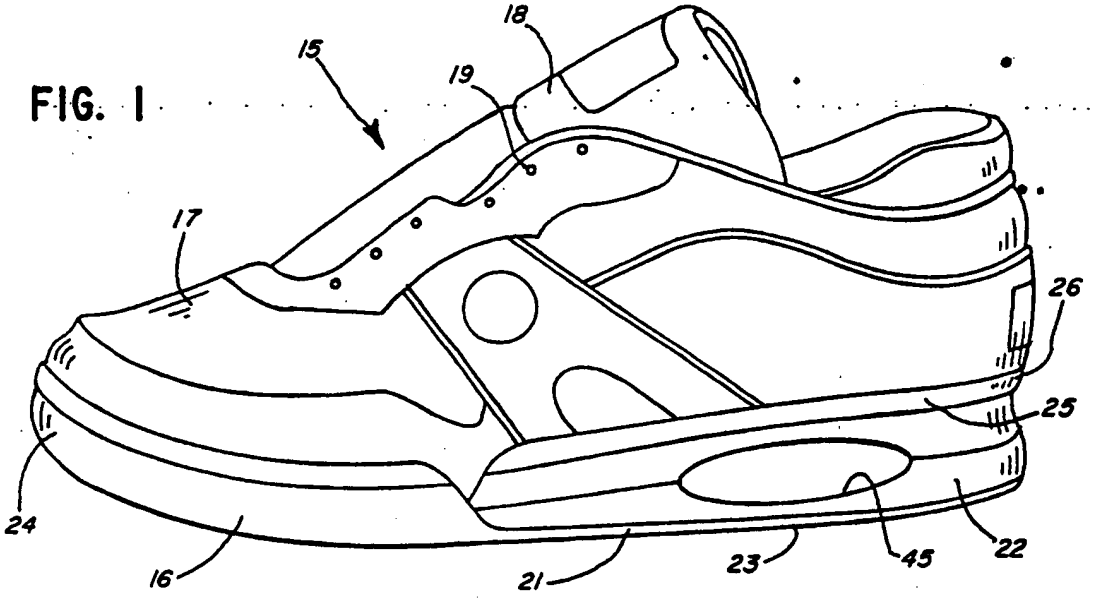


FIG. 2

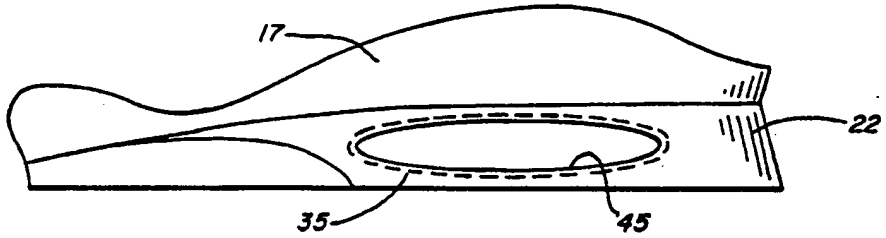
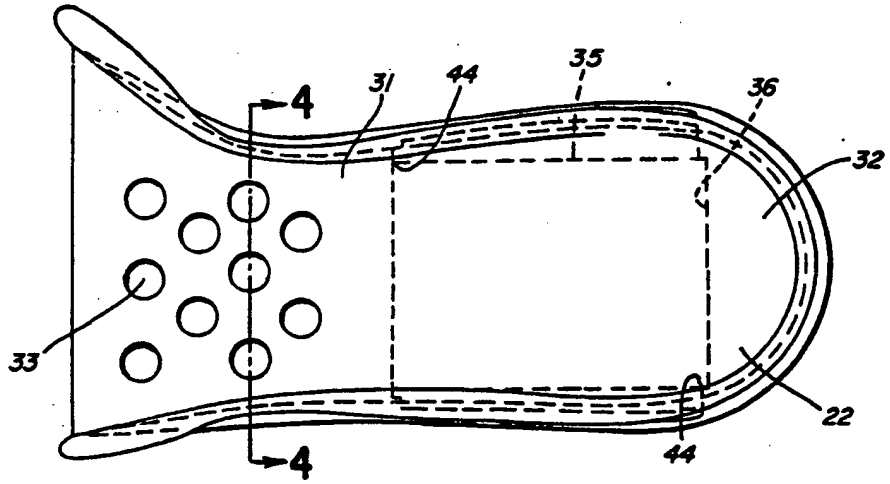


FIG. 3



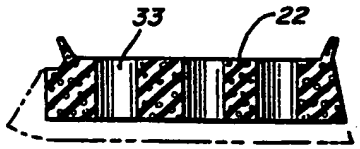
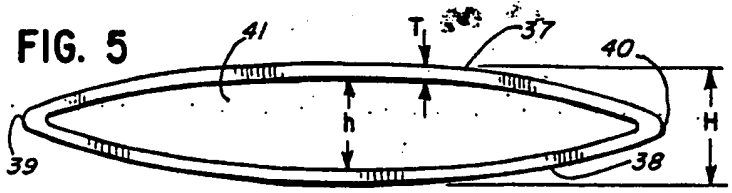


FIG. 4

FIG. 5



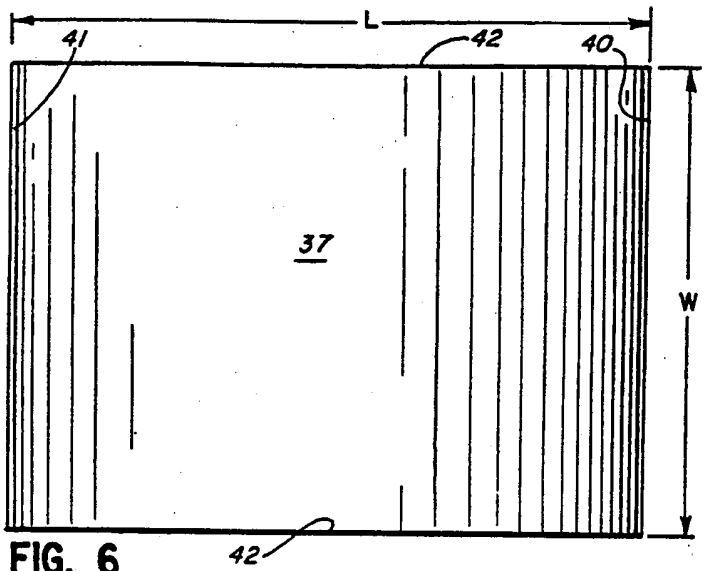


FIG. 6

FIG. 10

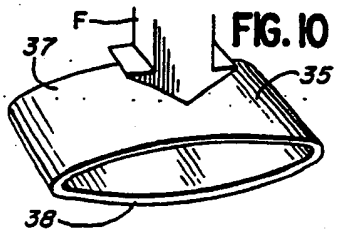
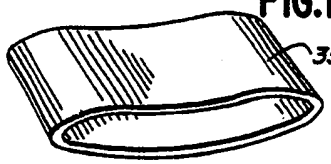


FIG. 11



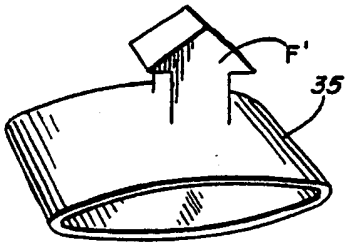


FIG. 12

FIG. 7

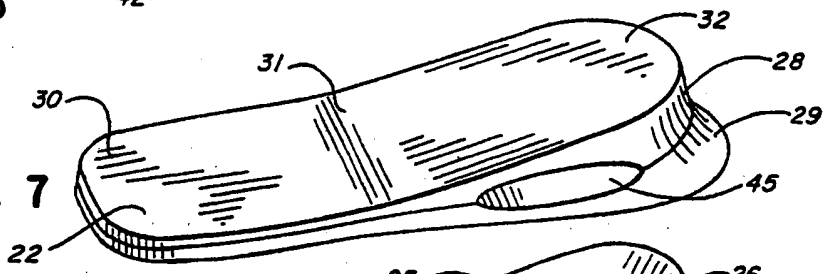


FIG. 8

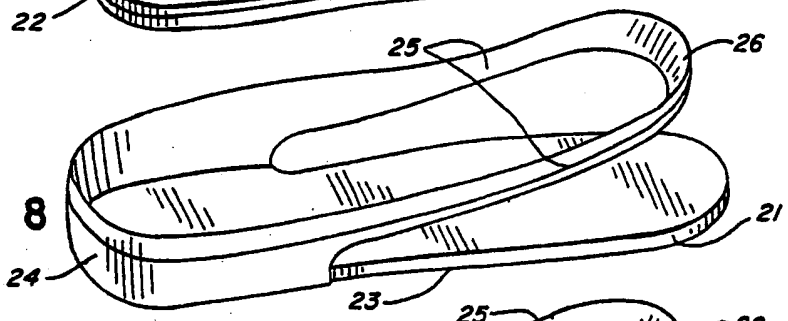


FIG. 9